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An Investigation of the Mussel Resource at Selected Locations Along the Alabama River, Alabama, 1999

Andrew C. Miller

September 2000

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Preface

This study was conducted during September 1999 for the U.S. Army Engineer District, Mobile, Mobile, AL, by personnel of the Environmental Laboratory (EL), Vicksburg, MS, U.S. Army Engineer Research and Development Center (ERDC).

Divers for this work were Messrs. Larry Neill, Johnny Buchanan, Rob James, and Bennie Kerley of the Tennessee Valley Authority, Muscle Shoals, AL. Assistance in the field was provided by Mr. Will Green, University of Southern Mississippi, Hattiesburg, MS. Maps and background information on the project area were provided by Messrs. Mike Eubanks, Mobile District, and Paul Hartfield, U.S. Fish and Wildlife Service, Jackson, MS.

During the conduct of this study, Dr. John W. Keeley was Director, EL; Dr. Conrad J. Kirby was Chief, Ecological Research Division, EL; and Dr. Alfred F. Cofrancesco was Chief of the Aquatic Ecology Branch, Ecological Research Division. This report was prepared by Dr. Andrew C. Miller, Aquatic Ecology Branch.

At the time of publication of this report, Dr. James R. Houston was Director of ERDC, and COL James S. Weller, EN, was Commander.

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1 Introduction

Background

The U.S. Army Engineer District, Mobile, is tasked with maintaining the navigation channel and small boat access channels along the Alabama River, Alabama. The waterway includes approximately 465 km (289 miles) between the confluence of the Alabama and Tombigbee rivers upriver to Montgomery, AL. The existing project provides for maintenance dredging and rock training dikes in the Federally authorized navigational channel. Maintenance is normally conducted with a hydraulic pipeline dredge, dragline, or clamshell between May and December. This is in combination with work on rock training dikes and flow management for Corps reservoirs. Dredged material is placed at previously approved within-bank disposal areas.

Proposed dredging, disposal of material, and other navigation maintenance activities could negatively affect freshwater mussels (Family: Unionidae), a resource with economic, ecological, and cultural value. In medium- to large-sized rivers, these organisms usually reach their highest density in shallow water close to shore and outside the navigation channel. They are most common in sand/gravel substratum that is kept relatively free of silt with moderate- to high-velocity water, 0.2 to 0.5 m/sec. Mussels are virtually nonmotile, require a fish host to successfully reproduce, and feed by filtering organic matter out of the water column. Shells of many species were used to make buttons before the advent of plastics; today shells of certain species are used to produce cultured pearls. Williams et al. (1993) listed nearly 300 species of freshwater mussels in this country; 71.7 percent were considered to be endangered, threatened, or of special concern.

Potamilus inflatus, the inflated heelsplitter mussel, was listed as threatened in 1990 by the U.S. Fish and Wildlife Service. In 1998, a fresh dead shell of this species was collected on the Alabama River at River Mile (RM) 20.5 (Hartfield and Garner 1998). This species typically inhabits fine-grained, stable substratum in slow to moderate currents (Stern 1976; Hartfield 1988a, 1988b). *Potamilus inflatus* has also been recently collected alive in the Amite River, Louisiana (U.S. Fish and Wildlife Service 1994), the Black Warrior and Tombigbee rivers, Alabama (Miller 1994), and the Pearl River, Mississippi (Miller and Payne 1996; George, Dickerson, and Reine 1995).

Early in 1998 Hartfield and Garner (1998) sampled a series of sites in the lower Alabama River to locate beds and to provide preliminary information on relative abundance and number of species at each site. Later that year, the Environmental Laboratory, U.S. Army Engineer Research and Development Center (ERDC), quantitatively sampled four high-density mussel beds identified by Hartfield and Garner. These beds were located at RM 20.2-20.4, 30.1-30.4, 121.8-122.6, and 124.4-124.9 during the 1998 survey. Historical information on mussels of this river can be found in van der Schalie (1981), who listed species from the river, and cited Hartman and Call for information on the mainstem and H. H. Smith for information on selected tributaries. Van der Schalie listed 10 species, 3 of which were collected during this survey.

Purpose and Scope

This report summarizes results of a mussel survey between RM 12.5 and 67.3 in the Alabama River, Alabama. The purpose was to search for common and uncommon mussels at locations in the river where either channel maintenance or rock training dikes could be required.

2 Study Area and Methods

Study Area

A total of 17 locations were searched for mussels along the Alabama River between RM 12.5 and 72.4 (Table 1). The project area began north of the junction of the Alabama and Tombigbee rivers, and extended upriver toward Grove Hill and Monroeville, AL (Figure 1). This river reach was characterized by stable, well-vegetated banks. The shoreline was narrow, except when there were extensive sand and gravel bars. Substratum consisted mainly of sand and gravel, occasionally with deposits of clay or mud. Aquatic plants were typically absent, although fallen trees were common at most locations. Detailed descriptions of sample sites are in Chapter 3 of this report.

Methods

Before sampling was initiated, the upriver and downriver extent of each navigation channel improvement area was delineated using aerial photographs and maps. Two to five sites were identified at each location for divers and nondivers to search. Sampling was conducted in September 1999.

Two divers worked simultaneously along upriver and downriver transects at each navigation channel improvement area. They were equipped with surface-supplied air, communications equipment, and a pneumofathometer to record water depth and were tethered to the boat with a 100-m line. Before each dive, instructions were given on possible safety concerns, as well as conditions of depth, water velocity, and substratum. Usually the diver began at the stern of the boat and moved downriver the extent of his tether line for about 7 min. He then moved inshore approximately 2 to 3 m, then worked back upriver to the boat. One diver collected along a nearshore transect, and the other worked along a farshore transect. Divers communicated information on substratum conditions, water velocity, water depth, and presence of mussels to the tenders. Each diver searched for a specific time period, usually 15-20 min, along each transect.

Nondivers worked in water less than 1.0 m deep. They searched mainly by feel since visibility was poor. Typically the nondivers worked 100- to 200-m

lengths of shoreline adjacent to the sites where divers worked. In many cases, nondivers worked virtually the entire riverbank of a navigation channel improvement area. Nondivers typically searched 15-20 min at each collecting site depending on conditions.

At the end of collecting at each location, all shells and live mussels were returned to the boat or a station onshore. Live organisms were counted, identified, and returned to the river. Live mussels were replaced in the river in an area upriver of the navigation channel improvement area with similar conditions of water depth and velocity. Mussel taxonomy is consistent with Williams et al. (1993).

At selected sites, quantitative samples were obtained by having a single diver excavate all sand, gravel, and shells from within a 0.25-m² aluminum quadrat. For the most part, these quantitative samples yielded few or no mussels. Therefore, it was not possible to estimate densities at these locations using quantitative methods.

Latitude and longitude were collected at each study area using a hand-held Global Positioning System (GPS) (Garmin GPS12XL Personal Navigator) (Table 2). Coordinates obtained in the field, in conjunction with information stored in *Street Atlas Version 6.0* (Delorme 1997), were used to produce maps. Based upon information provided by Garmin, Inc., Olathe, KS, there can be an error of approximately 5-100 m when this equipment is used.

3 Results and Discussion

Existing Conditions

Approximately 700 live mussels were collected at 17 locations along the river (Table 3). Total collecting time was 3,300 min, ranging from a low of 15 min near Claiborne Lock and Dam to 420 min at Mrs. Gray's Bar. Collecting rate (where mussels were found) ranged from a low of 0.02/min at Claiborne Bridge to a high of 0.69/min at Dixie Cutoff. Mean collecting rate was 0.20 mussel/min.

Fourteen species were collected in addition to the nonindigenous Asian clam, *Corbicula fluminea* (Tables 4, 5, and 6). The fauna was dominated by *Quadrula asperata* (Alabama orb) which composed 27.7 percent of the fauna. Four other species, *Obliquaria reflexa* (threehorn wartyback), *Fusconaia ebena* (ebonyshell), *Lampsilis teres* (yellow sandshell), and *L. ornata* (southern pocketbook) each composed 16.6 to 10.2 percent of the fauna. The remaining nine species each composed 7 percent or less of the fauna. Less than half the samples, 41 percent, contained at least one *F. ebena*. The remaining 13 species were taken in less than 25 percent of the samples.

The relationship between cumulative number of species and individuals collected gives an indication of the difficulty of finding uncommon organisms (Figure 2). After 200 mussels were collected, 10 species were identified. Slightly more than 70 percent of the species were identified after only about 33 percent of the mussels had been collected. After 400 more mussels were collected, only 4 new species were added to the list. A similar relationship is apparent when the cumulative number of species collected is compared with the cumulative time spent working (Figure 3). After slightly more than 500 min, 15 percent of the total time expended, 10 species, or 71 percent of the total, were taken. Figures 2 and 3 illustrate that many of the species in this reach of the river were common and easily collected.

Typically 4 or fewer species and 20 or fewer individuals were taken at any one site (Figure 4). At only 4 of the 17 sites were more than 50 individuals taken, and at only 3 sites were more than 4 species found. Most sites that were surveyed had low species richness and low density.

Thirteen and sixteen samples collected by divers in water > 1.0 m deep and waders in water < 1.0 m deep, respectively, had no species present (Figure 5). Overall, divers were able to collect slightly more species at any one location than did the waders. Divers collected nearly twice the number of mussels in deep water (424) as the waders in shallow water (244).

The relationship between collecting rate and navigation mile indicated that slightly more species were located in the midriver (RM 30-50) and downriver (RM 0-30) reaches than the upriver reaches (RM 50-80) (Figure 6). The number of species collected at a site by both divers and waders showed no particular trends with respect to river mile (Figure 7).

Description of Study Areas

Information on the type of maintenance activities planned for each area was obtained from the Mobile District. Conditions of substratum, water depth, and bank stability were obtained from field notes made during collecting. The value of each area for mussels was assessed based upon field notes and the number of mussels collected (Table 3). At an area rated "high," more than 100 live mussels were collected with at least 7 species identified. From 10 to 50 live mussels and 4 to 6 species were found at areas rated "medium." If less than 10 live mussels and typically fewer than 3 species were collected, then the area was judged to have low value for mussels. No rating system is perfect, and there are some possible ambiguities in this one, which are noted in the following paragraphs.

Wolf Gut

Wolf Gut was located along the left descending bank (LDB) of the river between RM 12.5 and 12.7, waypoints 1 and 2 (Figure 8). In this reach the channel is narrow, which can cause large navigation vessels to run aground, resulting in shipping delays. The Mobile District wants to investigate the possibility of easing the bend at this location to reduce delays.

This reach had medium value for mussels (Table 3). A total of 3 species and 17 individuals were collected. The collecting rate, 0.08 individual/min, was low in comparison with the overall mean of 0.20 individual/min. Approximately 2.5 percent of all the mussels collected during the trip were found at Wolf Gut.

Aberdeen Wreck

This site was located along the LDB between RM 19.9 and 20.3 at waypoints 3 and 4 (Figure 8). Existing training works along the LDB do not work well, the channel is poorly marked, and there is a crossing from right to left bank. The Mobile District wants to investigate the feasibility of constructing training dikes along the LDB.

This river reach was judged to have high value for mussels. A total of 9 species and 131 individuals (nearly 20 percent of the total collected) were found. The substratum was stable and consisted of sand and gravel. Although no uncommon or endangered species were collected, this was one of the better areas for mussels. However, this area was not a high-quality mussel bed such as the one identified by Hartfield and Garner in 1998 and studied by ERDC in 1999.

In 1998 Hartfield and Garner (1998) collected 94 mussels and 8 species at a bed located along the right descending bank (RDB) between RM 20.2 and 20.4, just upriver of this location. A fresh dead *P. inflatus* (the inflated heelsplitter, Federally listed as endangered) was collected, which was the only recent find of this species in the Alabama River. *Potamilus inflatus* was not catalogued in the collection of the Tulane Museum of Natural History (1964-1974) but was reported by E. A. Smith in 1876 (Hartfield and Garner 1998). In 1998, personnel from ERDC conducted quantitative surveys at this mussel bed and found that mean density was low, 8.8 mussels/m². A total of eight species were collected, and there was some evidence of recent recruitment. Three species and 13.6 percent of the individuals were less than 30 mm total shell length. Evidence of recent recruitment was found for *F. ebena*, *O. reflexa*, and *Truncilla donaciformis*.

Lower Earl's Bar

Collecting sites were located between RM 22 and 22.5 along the LDB at waypoints 5 and 6 (Figure 8). There is concern over shoaling at RM 22.5, and the Mobile District wants to investigate the feasibility of constructing a longitudinal dike along the right side of the channel.

This site was judged to have medium value for mussels; 4 species and 13 individuals were collected at a rate of 0.07 individual/min. Substratum was stable, although it lacked coarse gravel.

Upper Earl's Bar

Upper Earl's Bar was located along the LDB between RM 23 and 23.5 at waypoints 7 and 8 (Figure 8). A large shoal was located below the most downriver dike along the island along the RDB. The Mobile District wants to investigate the feasibility of constructing a revetment along the LDB to prevent erosion of existing upland disposal areas. Erosion from the disposal areas could be contributing to the shoaling problem.

Upper Earl's Bar had a mussel fauna very similar to Lower Earl's Bar and was also rated medium for mussels. A total of 4 species and 15 individuals were collected. The collecting rate, 0.09 individual/min, was only slightly greater than that at Lower Earl's Bar.

Dixie Cutoff

The work area was located along the RDB between RM 25.2 and 25.8. Samples were taken at waypoints 9 and 10 along the LDB (Figure 9). The channel is very narrow at this location, and a large shoal runs along the LDB. The river appears to be trying to go down the cutoff and is eroding the RDB. Exposed stumps that are potentially hazardous and impede navigation should be removed. The Mobile District wants to investigate the feasibility of removing the stumps and constructing a revetment along the RDB. The bottom along the RDB consisted of scoured clay with no substratum suitable for mussels.

The quality of the mussel fauna at this location was considered to be high; 8 species and 104 individuals, 15.6 percent of the total, were collected. This area had high-quality stable substratum composed of sand and gravel that was very suitable for mussels.

Lower Madison

Lower Madison was located along the LDB between RM 28.5 and 31 at waypoints 11, 12, and 13 (Figure 9). Dredging is required to maintain the channel. The Mobile District is considering the installation of training works along the LDB.

This location was judged to have high value for mussels. Eight species and 55 individuals were collected and the collecting rate was 0.22 individual/min, slightly above the overall average. A single *Leptodea fragilis* (papershell), which is uncommon in this river reach, was collected.

Red Eagle Landing

This site was located along the LDB between RM 34.2 and 34.8 at waypoints 14, 18, and 19 (Figure 9). The river is experiencing some shoaling in this reach. The Mobile District wants to investigate the feasibility of constructing training dikes along the LDB.

Substratum was stable and consisted of sand and gravel. The water was shallow and the riverbank was less than 45 deg and well-vegetated. This area was judged to have medium value for mussels although biotic findings indicate it could be rated medium or low. Fewer than 10 species were collected (which would yield a low rating), although more than 3 species were collected (which could make the area rate medium). However, since the bank was stable and the substratum suitable, this area was judged to have a medium value for mussels although few individuals were collected.

Carter's Bar

Carter's Bar was located on both riverbanks between RM 40.6 and 41.1 at waypoints 15, 16, and 17 (Figure 10). Samples were actually taken along both sides of the river although GPS coordinates show sites only along the LDB. The training dikes do not work well, and there is a tremendous shoaling problem. Both dredging and bank training devices could be required to improve the navigation channel through this reach.

The RDB along the section downriver of this area was well-vegetated, the bank stable and gently sloping. Along the RDB at RM 40.8 the bank was poorly vegetated and not very stable. The LDB consisted of a wide sandy bar. Virtually all of the mussels were collected in deep water along the LDB at RM 40.4. At this location a total of 81 individuals and 7 species were collected, and its value for mussels was considered high. Collecting rate was 0.37 individual/min which was about twice the overall mean collecting rate of 0.20 individual/min.

California Bar

California Bar is located between RM 42.6 and 43 along the RDB at waypoints 20, 21, and 22 (Figure 10). The channel is very narrow, and shoaling occurs below the most downstream dike. The Mobile District wants to investigate the feasibility of constructing an L-head dike below existing dikes.

Along the RDB was a sandy shoal, and the gently sloping (< 45 deg) bank was well-vegetated. The LDB consisted mainly of sandy deposits and dikes. A total of 7 species and 33 individuals were collected. Collecting rate was 0.16 individual/min. A single *P. inflatus* (inflated heelsplitter), listed as endangered, was collected in water approximately 2 m deep at RM 42.6 (waypoint 21). Aside from the single find of *P. inflatus*, no other unusual or very uncommon mussels, with the possible exception of a single *L. fragilis*, was found at this location.

A total of 210 min was spent looking for mussels at California Bar on 17 September. On the last survey day another 200 min of search time was spent on both riverbanks. No more *P. inflatus* was found.

Since less than 50 live mussels were collected, this area should rate as medium value for mussels. However, a total of seven species were identified so the area could be rated as high. The presence of a single *P. inflatus* has great interest for managers and planners, although the presence of only a single specimen indicates that this river reach is not necessarily critical for the species. The area was rated as having high value for all mussels although it should be understood that in comparison with other areas surveyed with a high habitat value the total number of mussels collected was low.

Shackleford Dike Field

This area for dikes is on both sides of the river between RM 46.2 and 47.1 and is at waypoints 23-27 (Figure 11). Shoaling is a problem between RM 46.6 and 47.1. There is poor visibility at high water, and this area is very hazardous for navigation. A total reexamination of this site would be required to make it safe for commercial navigation.

Portions of this river reach were characterized by eroding banks and fallen trees; banks were gently sloping although eroding in places. Large deposits of sand were found around dikes. This reach had high value for mussels; a total of 107 individuals (16 percent of the total) and 9 species were collected. However, no unusual or uncommon species were found, and the fauna consisted mainly of approximately equal numbers of *Q. asperata* (Alabama orb), *O. reflexa* (threehorn wartyback), and *F. ebena* (ebonyshell). One specimen each of *L. fragilis* (papershell), and *P. purpurata* (bleufer), and *Plectomerus dombeyanus* (bankclimber) were collected.

Bailey Creek

The Bailey Creek site is located on the RDB between RM 49.2 and 49.6 at waypoints 28, 29, and 30 (Figure 11). Shoaling occurs downstream of the dikes on the RDB at RM 49.5. The Mobile District wants to investigate the feasibility of constructing an L-head on the lower dike and/or constructing transition dikes on the RDB.

No mussels were found at Bailey Creek. The substratum was sandy and unstable, although the banks were well-vegetated with little evidence of recent erosion. Shoaling from the dikes made conditions unsuitable for mussels.

Lovett's Creek

The Lovett's Creek site is located on the LDB between RM 51.2 and 51.4 at waypoints 31 and 32 (Figure 11). This area is hazardous because of shoaling at the mouth of the creek on the left bank and a rock obstruction at the mouth of the creek. The Mobile District wants to investigate the feasibility of constructing a training dike on the left bank of Lovett's Creek.

At this site the bank was steep and eroding, although well-vegetated with trees and herbaceous plants. The river bottom consisted of sand and gravel with some mud and clay. This reach was judged to have high value for mussels; 11 species (more than at any other site) and 58 individuals were collected at a rate of 0.39 individual/min. In addition to the common species, one each of the following uncommon species were collected: *P. purpuratus* (bleufer), *Elliptio crassidens* (elephant-ear), *Megalonaias nervosa* (washboard), *Ellipsaria lineolata* (butterfly), and *F. cerina* (gulf pigtoe).

Mrs. Gray's Bar

This site is on both sides of the river between RM 57.7 and 58.5 at waypoints 33-38 (Figure 12). The crossing at RM 58.5 is shallow and narrow and can cause navigation delays. This problem could be alleviated by extending the upriver training works field along the RDB.

The bank along portions of this reach was steep and eroding. The bank near the water was free of vegetative cover, although the upper section was stabilized with trees and herbaceous vegetation. A total of 6 species and 13 individual mussels were collected. Mussels were collected at the rate of 0.03 individual/min. This river reach had medium value for mussels.

Choctaw Creek

The Choctaw Creek site is on the RDB between RM 60.9 and 61.1 at waypoints 39 and 40 (Figure 12). There is considerable shoaling at this location. The Mobile District wants to investigate the feasibility of constructing a training dike along the RDB at the mouth of Choctaw Creek.

The riverbank was stable, with less than a 45-deg slope, and covered with trees and herbaceous vegetation. Substratum along the shoreline and in the water consisted of gravel and sand. A total of 5 species and 14 individual mussels were collected; this site had medium value for mussels.

Claiborne Bridge

The Claiborne Bridge Site is located on the RDB between RM 66.5 and 66.8 at waypoints 41 and 42 (Figure 13). Shoaling occurs below the bridge and a dike field located along the RDB. The Mobile District wants to investigate the feasibility of constructing a downstream training dike to reduce shoaling.

Substratum in this river reach consisted of sand and mud, and within 25 m of shore the water was less than 0.5 m deep. There was much evidence of shoaling along the RDB. Banks had less than a 45-deg slope and were well-vegetated. Two species and three mussels were collected. Mussels were collected at the rate of 0.02 mussel/min and the area was judged to have low value.

Limestone Creek

This site is located on the LDB between RM 67.4 and 67.7 at waypoints 43 and 44 (Figure 13). The Mobile District wants to investigate the feasibility of extending the existing dike along the left bank.

Substratum consisted of sand with only small amounts of gravel. The water was shallow, and there was considerable exposed sand. Five species and fifteen mussels were collected. Mussels were collected at the rate of 0.10 individual/min, and the area was judged to have medium value.

Claiborne Lock and Dam

This site was immediately west of the lock wall at Claiborne Lock and Dam at waypoint 45 (Figure 13). Severe shoaling occurs annually at the lock wall. The Mobile District wants to investigate the feasibility of constructing dikes to prevent shoaling along the lock wall. No mussels were collected in 15 minutes of searching.

4 Conclusions

Seventeen areas were searched for freshwater mussels between RM 12.5 and 72.4 in the Alabama River in 1999. Seven were judged to have high value for mussels, based on the number of individuals and species collected: Aberdeen Wreck, Dixie Cutoff, Lower Madison, Carter's Bar, Shacklefield Dike Field, Lovett's Creek, and California Bar. At this latter area comparatively few live individuals were collected, although a single endangered *P. inflatus* was found; therefore the area was judged to have high value for mussels. None of these river reaches supported high-density mussel populations. Low-quality mussel habitat was likely the result of poor substratum quality (lack of gravelly sands), and the erosive nature of the area due to high-velocity water. In addition, sediment deposition caused by erosive action of the water immediately upriver was an additional factor that decreased the habitat value of many of these areas.

All sites surveyed were characterized by low species richness as well as low density. In addition, compared with other mussel beds in the southeastern United States, sites surveyed in 1999 had relatively low diversity indices (Shannon's diversity index). This was the result mainly of the high dominance of relatively few species. Quantitative samples were obtained at four locations; however, not enough mussels were present to make this effort worthwhile. It was estimated that overall density at sites surveyed in 1999 was never greater than 2-3 individuals/m². In 1998, high-density beds were found at Alabama River miles 121.8-122.6 and 124.4-124.9. Mean density at those two beds was 164.0 and 116.8 individuals/m², respectively. It is not uncommon to find mean densities of approximately 100 individuals/m² or more at extensive mussel beds in the central and southern United States (Miller, Payne, and Hartfield 1992; Way, Miller, and Payne 1989).

References

- Delorme. (1997). "Street Atlas Version 6.0" (computer program), Yarmouth, ME.
- George, S. G., Dickerson, D. D., and Reine, K. J. (1995). "Rediscovery of the inflated heelsplitter mussel, *Potamilus inflatus*, from the Pearl River Drainage," *Journal of Freshwater Ecology* 11, 245-246.
- Hartfield, P. (1998a). "Mussel survey for the Amite River, Louisiana, 9-13 May 1988," Report for Espey Huston and Associates, Inc., Jackson, MS.
- Hartfield, P. (1998b). "Status survey for the Alabama heelsplitter mussel, *Potamilus inflatus* (Lea 1831)," Report to the U.S. Fish and Wildlife Service, Jackson, MS.
- Hartfield, P., and Garner, J. (1998). "Report on dive surveys of the lower Alabama River, 1998," Report prepared by U.S. Fish and Wildlife Service, Jackson, MS, and Alabama Department of Conservation and Natural Resources.
- Miller, A. C. (1994). "A survey of the Tombigbee and Black Warrior River for the endangered heelsplitter mussel, *Potamilus inflatus*," Technical Report EL-94-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Miller, A. C., and Payne, B. S. (1996). "Freshwater mussels of the West Pearl River, Mississippi and Louisiana," Technical Report EL-97-21, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Miller, A. C., Payne, B. S., and Hartfield, P. D. (1992). "Characterization of a dense mussel bed in the Big Sunflower River, Mississippi," *Journal of the Mississippi Academy of Sciences* 37(3), 8-11.

- Stern, E. M. (1976). "The freshwater mussels (Unionidae) of the Lake Maurepas-Ponchartrain-Borgne Drainage System, Louisiana and Mississippi," Ph.D. Dissertation, Louisiana State University, Baton Rouge, LA.
- U.S. Fish and Wildlife Service. (1994). "Endangered and threatened wildlife and plants," 50 CFR 17.11 & 17.12, *Federal Register*, July 15, 1994.
- van der Schalie, H. (1981). "Perspectives on North American malacology 1. Mollusks in the Alabama River, USA, drainage, past and present," *Sterkiana* 71, 24-40.
- Way, C. M., Miller, A. C., and Payne, B. S. (1989). "The influence of physical factors on the distribution and abundance of freshwater mussels (Bivalvia: Unionidae) in the lower Tennessee River," *The Nautilus* 103, 96-98.
- Williams, J. D., Warren, M. L., Jr., Cummings, K. S., Harris, J. L., and Neves, R. J. (1993). "Conservation status of freshwater mussels of the United States and Canada," *Fisheries* 18, 6-22.

Table 1
Summary Information on Sample Locations along the Alabama River, 1999

Location	Shore ¹	Navigation Mile		Length km (miles)	Waypoints	Figure
		Downriver	Upriver			
Wolf Gut	LDB	12.5	12.7	0.3 (0.2)	1, 2	8
Aberdeen Wreck	LDB	19.9	20.3	0.6 (0.4)	3, 4	8
Lower Earl's Bar	LDB	22	22.5	0.8 (0.5)	5, 6	8
Upper Earl's Bar	LDB	23	23.5	0.8 (0.5)	7, 8	8
Dixie Cutoff	LDB	25.2	25.8	1 (0.6)	9, 10	9
Lower Madison	LDB	28.5	31	4 (2.5)	11, 12, 13	9
Red Eagle Landing	LDB	34.2	34.8	1 (0.6)	14, 18, 19	9
Carter's Bar	Both	40.6	41.1	0.8 (0.5)	15, 16, 17	10
California Bar	RDB	42.6	43	0.6 (0.4)	20, 21, 22	10
Shackleford Dike Field	Both	46.2	47.1	1.4 (0.9)	23, 24, 25, 26, 27	11
Bailey Creek	RDB	49.2	49.6	0.6 (0.4)	28, 29, 30	11
Lovett's Creek	LDB	51.2	51.4	0.3 (0.2)	31, 32	11
Mrs. Gray's Bar	Both	57.7	58.5	1.3 (0.8)	33, 34, 35, 36, 37, 38	12
Choctaw Creek	RDB	60.9	61.1	0.3 (0.2)	39, 40	12
Claiborne Bridge	RDB	66.5	66.8	0.5 (0.3)	41, 42	13
Limestone Creek	LDB	67.4	67.7	0.5 (0.3)	43, 44	13
Claiborne L&D	LDB	72.2	72.4	0.3 (0.2)	45	13

¹ LDB = left descending bank; RDB = right descending bank.

Table 2
Global Positioning System Coordinates for Sites Surveyed
on the Alabama River, 1999

Waypoint	Latitude	Longitude
1	31.21221	87.85015
2	31.21032	87.84770
3	31.26124	87.83089
4	31.26368	87.83013
5	31.27551	87.81057
6	31.27378	87.80808
7	31.26697	87.79992
8	31.26838	87.79615
9	31.29758	87.79253
10	31.29376	87.79750
11	31.31358	87.78255
12	31.33208	87.78148
13	31.33834	87.77199
14	31.35183	87.75360
15	31.38813	87.71089
16	31.38569	87.71252
17	31.38213	87.71472
18	31.35012	87.75437
19	31.34826	87.75438
20	31.40562	87.69553
21	31.40530	87.69717
22	31.40311	87.70064
23	31.41218	87.62629
24	31.41401	87.62748
25	31.41185	87.62693
26	31.42333	87.63582
27	31.42634	87.64003
28	31.41021	87.60260
29	31.41010	87.60385
30	31.41235	87.60009
31	31.43273	87.57482
32	31.43059	87.57770
33	31.50333	87.61111
34	31.50372	87.60938
35	31.50852	87.61358
36	31.50699	87.61364
37	31.51008	87.61840
38	31.51160	87.61893
39	31.53226	87.59457
40	31.53371	87.59342
41	31.54653	87.51909
42	31.55067	87.51600
43	31.55596	87.51290
44	31.55909	87.51292
45	31.61231	-45.00000

Table 3
Number of Mussel Species, Individual Mussels, and Time Expended, Alabama River, 1999

Location	No. of Species	No. of Mussels	Time min	Mussels/min	Value for Mussels ¹
Wolf Gut	3	17	220	0.08	Medium
Aberdeen Wreck	9	131	200	0.66	High
Lower Earl's Bar	4	13	200	0.07	Medium
Upper Earl's Bar	4	15	170	0.09	Medium
Dixie Cutoff	8	104	150	0.69	High
Lower Madison	8	55	250	0.22	High
Red Eagle Landing	5	9	195	0.05	Medium
Carter's Bar	7	81	220	0.37	High
California Bar	7	33	210	0.16	High
Shackleford Dike Field	9	107	300	0.36	High
Bailey Creek	0	0	150	0.00	Low
Lovett's Creek	11	58	150	0.39	High
Mrs. Gray's Bar	6	13	420	0.03	Medium
Choctaw Creek	5	14	150	0.09	Medium
Claiborne Bridge	2	3	150	0.02	Low
Limestone Creek	5	15	150	0.10	Medium
Claiborne L&D	0	0	15	0.00	Low
Total mussels		668	3,300	0.20	

¹ An explanation of the rating system appears in the text.

Table 4
Summary Information on Freshwater Mussels Collected, Alabama River, September, 1999

Species	Common Name	Number	% Abundance	Occur
<i>Quadrula asperata</i>	Alabama orb	185	27.69	34
<i>Obliquaria reflexa</i>	Threehorn wartyback	111	16.62	20
<i>Fusconaia ebena</i>	Ebonysell	92	13.77	15
<i>Lampsilis teres</i>	Yellow sandshell	76	11.38	18
<i>Lampsilis ornata</i>	Southern pocketbook	68	10.18	3
<i>Quadrula apiculata</i>	Southern mapleleaf	47	7.04	10
<i>Plectomerus dombeyanus</i>	Bankclimber	41	6.14	12
<i>Potamilus purpurata</i>	Bleufer	20	2.99	14
<i>Elliptio crassidens</i>	Elephant-ear	13	1.95	6
<i>Leptodea fragilis</i>	Papershell	5	0.75	4
<i>Megaloniaia nervosa</i>	Washboard	4	0.60	2
<i>Ellipsaria lineolata</i>	Butterfly	3	0.45	3
<i>Fusconaia cerina</i>	Gulf pigtoe	2	0.30	2
<i>Potamilus inflatus</i>	Inflated heelsplitter	1	0.15	1
Total samples		83		

Table 5

Summary of Mussel Abundance Data for Selected Locations, Alabama River, 1999

Species	Wolf Gut	Aberdeen Wreck	Lower Earl's Bar	Upper Earl's Bar	Dixie Cutoff	Lower Madlson	Red Eagle Landing	Carter's Bar	California Bar
<i>Quadrula asperata</i>	0.00	18.32	0.00	60.00	19.23	29.09	11.11	54.32	12.12
<i>Obliquaria reflexa</i>	0.00	23.66	7.69	0.00	17.31	3.64	22.22	17.28	18.18
<i>Fusconaia ebena</i>	0.00	7.63	0.00	13.33	0.00	1.82	11.11	22.22	0.00
<i>Lampsilis teres</i>	17.65	16.79	23.08	20.00	6.73	18.18	33.33	0.00	54.55
<i>Lampsilis ornata</i>	0.00	5.34	0.00	0.00	37.50	40.00	0.00	0.00	0.00
<i>Quadrula apiculata</i>	5.88	23.66	30.77	0.00	1.92	1.82	0.00	1.23	6.06
<i>Plectomerus dombeyanus</i>	76.47	1.53	0.00	0.00	14.42	0.00	0.00	0.00	3.03
<i>Potamilus purpurata</i>	0.00	1.53	38.46	6.67	1.92	3.64	0.00	2.47	0.00
<i>Elliptio crassidens</i>	0.00	0.00	0.00	0.00	0.00	0.00	22.22	1.23	0.00
<i>Leptodea fragilis</i>	0.00	1.53	0.00	0.00	0.00	1.82	0.00	0.00	3.03
<i>Megalanaia nervosa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Ellipsaria lineolata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.23	0.00
<i>Fusconaia cerina</i>	0.00	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00
<i>Potamilus inflatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.03
Total mussels	17	131	13	15	104	55	9	81	33
Total species	3	9	4	4	8	8	5	7	7
Total time	220	200	200	170	210	250	195	220	210
Mussels/min	0.08	0.66	0.07	0.09	0.50	0.22	0.05	0.37	0.16
Percent of total	2.54	19.61	1.95	2.25	15.57	8.23	1.35	12.13	4.94

(Continued)

Table 5 (Concluded)

Species	Shacklefield Dike Field	Balley Creek	Lovett's Creek	Mrs. Gray's Bar	Choctaw Creek	Claiborne Bridge	Limestone Creek	Claiborne L&D
<i>Quadrula asperata</i>	32.71	0.00	18.97	23.08	57.14	66.67	53.33	0.00
<i>Obliquaria reflexa</i>	23.36	0.00	17.24	0.00	14.29	0.00	0.00	0.00
<i>Fusconaia ebena</i>	31.78	0.00	39.66	0.00	14.29	0.00	6.67	0.00
<i>Lampsilis teres</i>	2.80	0.00	3.45	0.00	0.00	0.00	13.33	0.00
<i>Lampsilis ornata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Quadrula apiculata</i>	0.00	0.00	5.17	15.38	0.00	0.00	0.00	0.00
<i>Plectomerus dombejanus</i>	0.93	0.00	6.90	15.38	0.00	0.00	20.00	0.00
<i>Potamilus purpurata</i>	0.93	0.00	1.72	7.69	7.14	33.33	6.67	0.00
<i>Elliptio crassidens</i>	5.61	0.00	1.72	15.38	7.14	0.00	0.00	0.00
<i>Leptodea fragilis</i>	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Megaloniaias nervosa</i>	0.00	0.00	1.72	23.08	0.00	0.00	0.00	0.00
<i>Ellipsaria lineolata</i>	0.93	0.00	1.72	0.00	0.00	0.00	0.00	0.00
<i>Fusconaia cerina</i>	0.00	0.00	1.72	0.00	0.00	0.00	0.00	0.00
<i>Potamilus inflatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total mussels	107	0	58	13	14	3	15	0
Total species	9	0	11	6	5	2	5	0
Total time	300	150	150	420	150	150	150	15
Mussels/min	0.36	0.00	0.39	0.03	0.09	0.02	0.10	0.00
Percent of total	16.02	0.00	8.68	1.95	2.10	0.45	2.25	??

Table 6
Frequency of Occurrence Data for Freshwater Mussels at Selected Locations, Alabama River, 1999

Species	Wolf Gut	Aberdeen Wreck	Lower Earl's Bar	Upper Earl's Bar	Dixie Cutoff	Lower Madison	Red Eagle Landing	Carter's Bar	California Bar
<i>Quadrula asperata</i>	0.00	75.00	0.00	100.00	50.00	50.00	20.00	50.00	50.00
<i>Obliquaria reflexa</i>	0.00	100.00	25.00	0.00	25.00	16.67	20.00	33.33	50.00
<i>Fusconaia ebena</i>	0.00	50.00	0.00	25.00	0.00	16.67	20.00	33.33	0.00
<i>Lampsilis teres</i>	25.00	50.00	50.00	25.00	50.00	33.33	20.00	0.00	50.00
<i>Lampsilis ornata</i>	0.00	25.00	0.00	0.00	25.00	16.67	0.00	0.00	0.00
<i>Quadrula apiculata</i>	25.00	50.00	25.00	0.00	25.00	16.67	0.00	16.67	16.67
<i>Plectomerus dombeyanus</i>	50.00	25.00	0.00	0.00	25.00	0.00	0.00	0.00	16.67
<i>Potamilus purpurata</i>	0.00	25.00	50.00	25.00	50.00	16.67	0.00	16.67	0.00
<i>Elliptio crassidens</i>	0.00	0.00	0.00	0.00	0.00	0.00	20.00	16.67	0.00
<i>Leptodea fragilis</i>	0.00	25.00	0.00	0.00	0.00	16.67	0.00	0.00	16.67
<i>Megalania nervosa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Ellipsaria lineolata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.67	0.00
<i>Fusconaia cerina</i>	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00
<i>Potamilus inflatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.67
Total samples	4	4	4	4	4	6	5	6	6

(Continued)

Table 6 (Concluded)

Species	Shacklefield Dike Field	Bailey Creek	Lovett's Creek	Mrs. Gray's Bar	Choctaw Creek	Claiborne Bridge	Limestone Creek	Claiborne L&D
<i>Quadrula asperata</i>	83.33	0.00	50.00	9.09	75.00	25.00	75.00	0.00
<i>Obliquaria reflexa</i>	66.67	0.00	50.00	0.00	25.00	0.00	0.00	0.00
<i>Fusconaia ebena</i>	66.67	0.00	50.00	0.00	25.00	0.00	25.00	0.00
<i>Lampsilis teres</i>	16.67	0.00	50.00	0.00	0.00	0.00	25.00	0.00
<i>Lampsilis ornata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Quadrula apiculata</i>	0.00	0.00	25.00	9.09	0.00	0.00	0.00	0.00
<i>Plectomerus dombejanus</i>	16.67	0.00	50.00	18.18	0.00	0.00	50.00	0.00
<i>Potamilus purpurata</i>	16.67	0.00	25.00	9.09	25.00	25.00	25.00	0.00
<i>Elliptio crassidens</i>	16.67	0.00	25.00	9.09	25.00	0.00	0.00	0.00
<i>Leptodea fragilis</i>	16.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Megalania nervosa</i>	0.00	0.00	25.00	9.09	0.00	0.00	0.00	0.00
<i>Ellipsaria lineolata</i>	16.67	0.00	25.00	0.00	0.00	0.00	0.00	0.00
<i>Fusconaia cerina</i>	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00
<i>Potamilus inflatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total samples	6	4	4	11	4	4	4	??

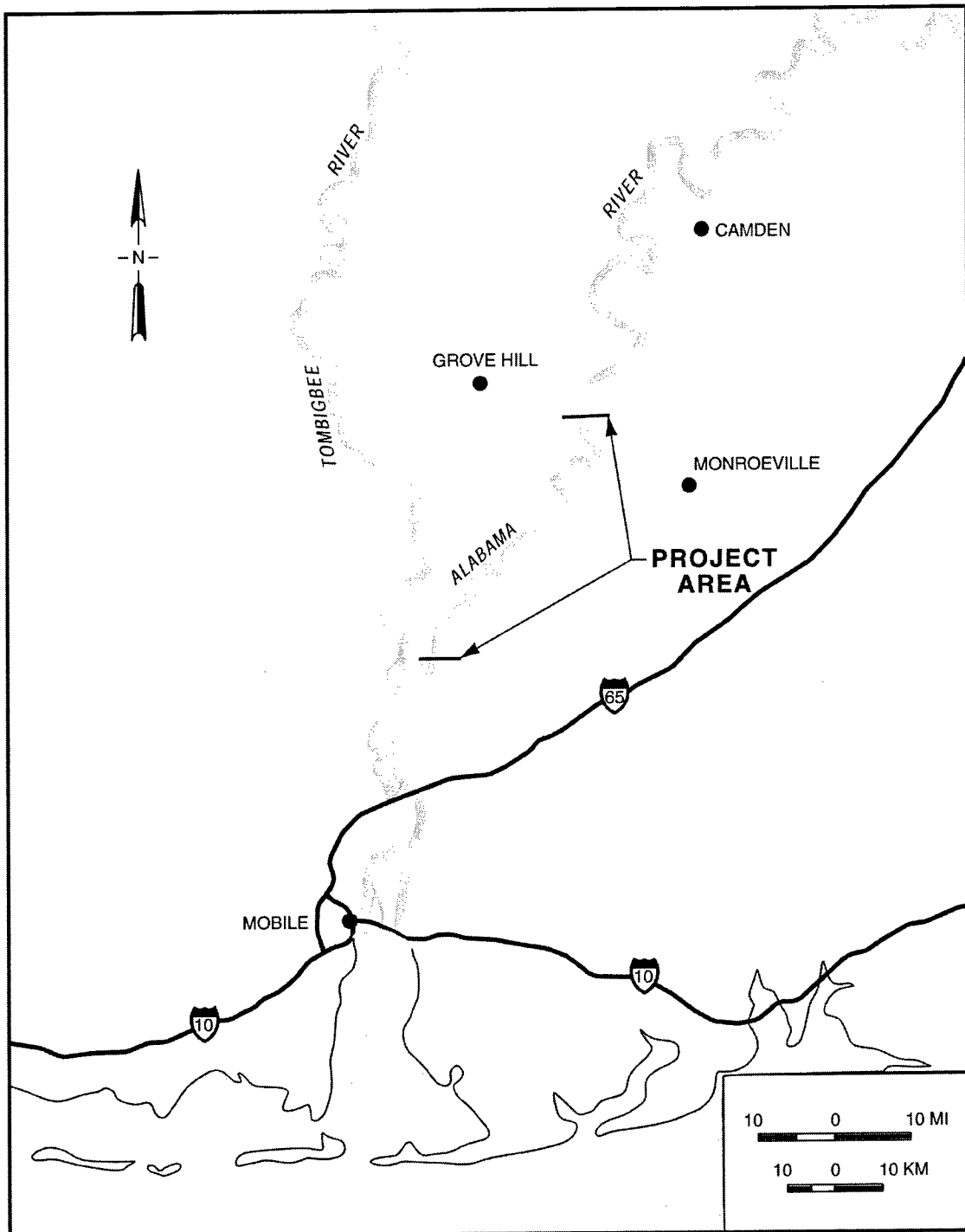


Figure 1. The study area

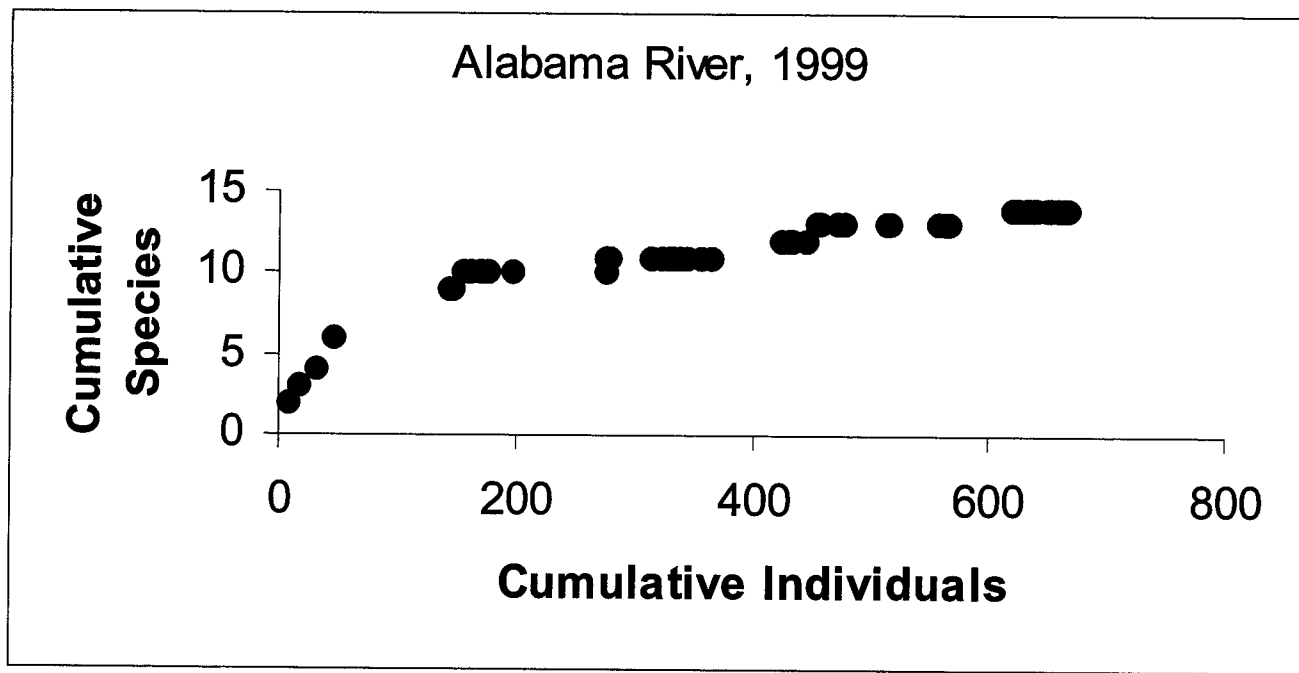


Figure 2. Cumulative number of species versus cumulative number of mussels collected, Alabama River, 1999

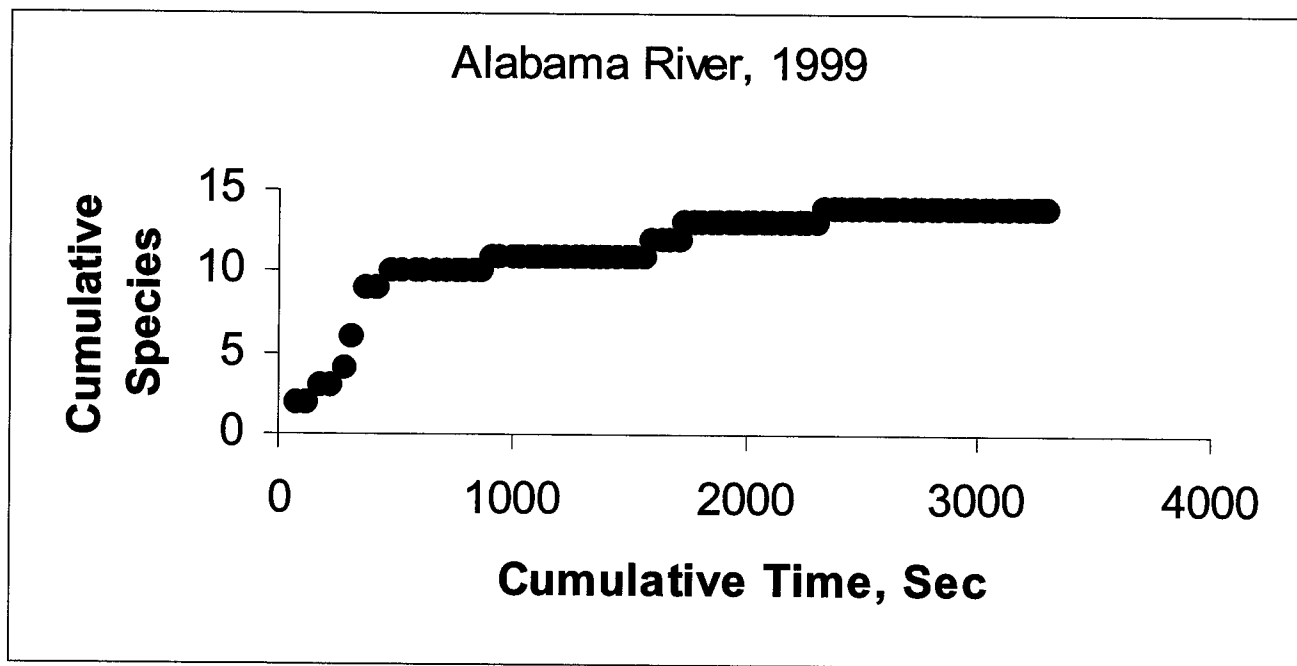


Figure 3. Cumulative number of species versus cumulative time expended collecting, Alabama River, 1999

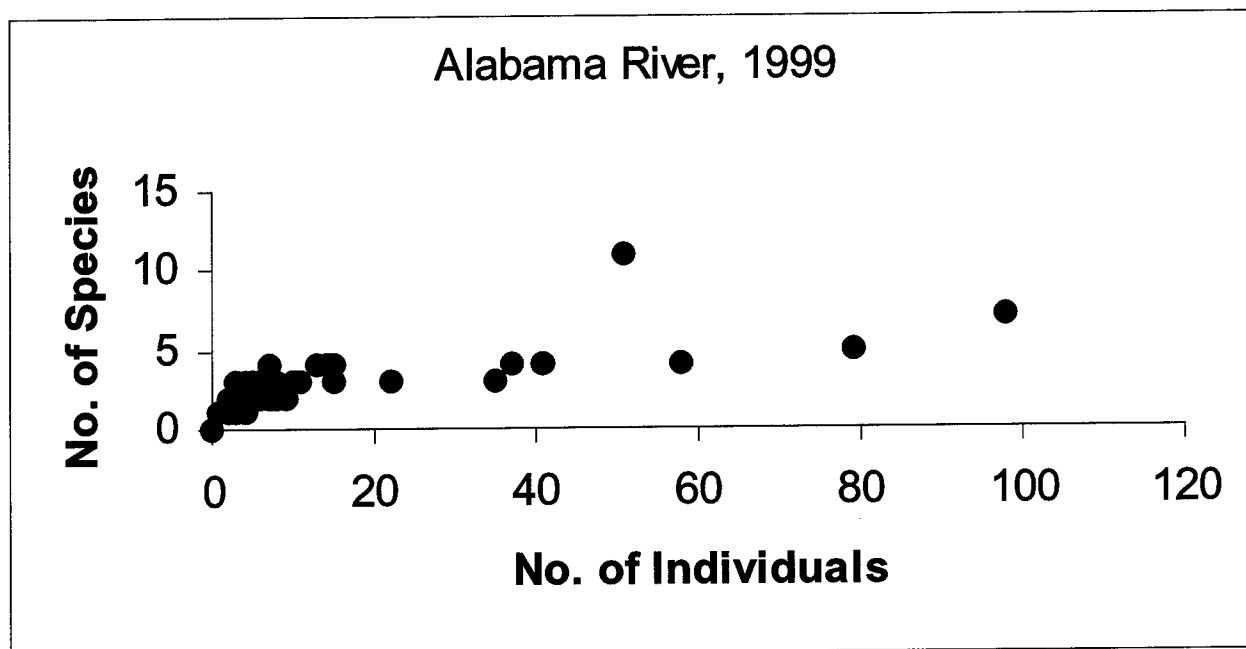


Figure 4. Number of species collected versus the number of individuals in that collection, Alabama River, 1999

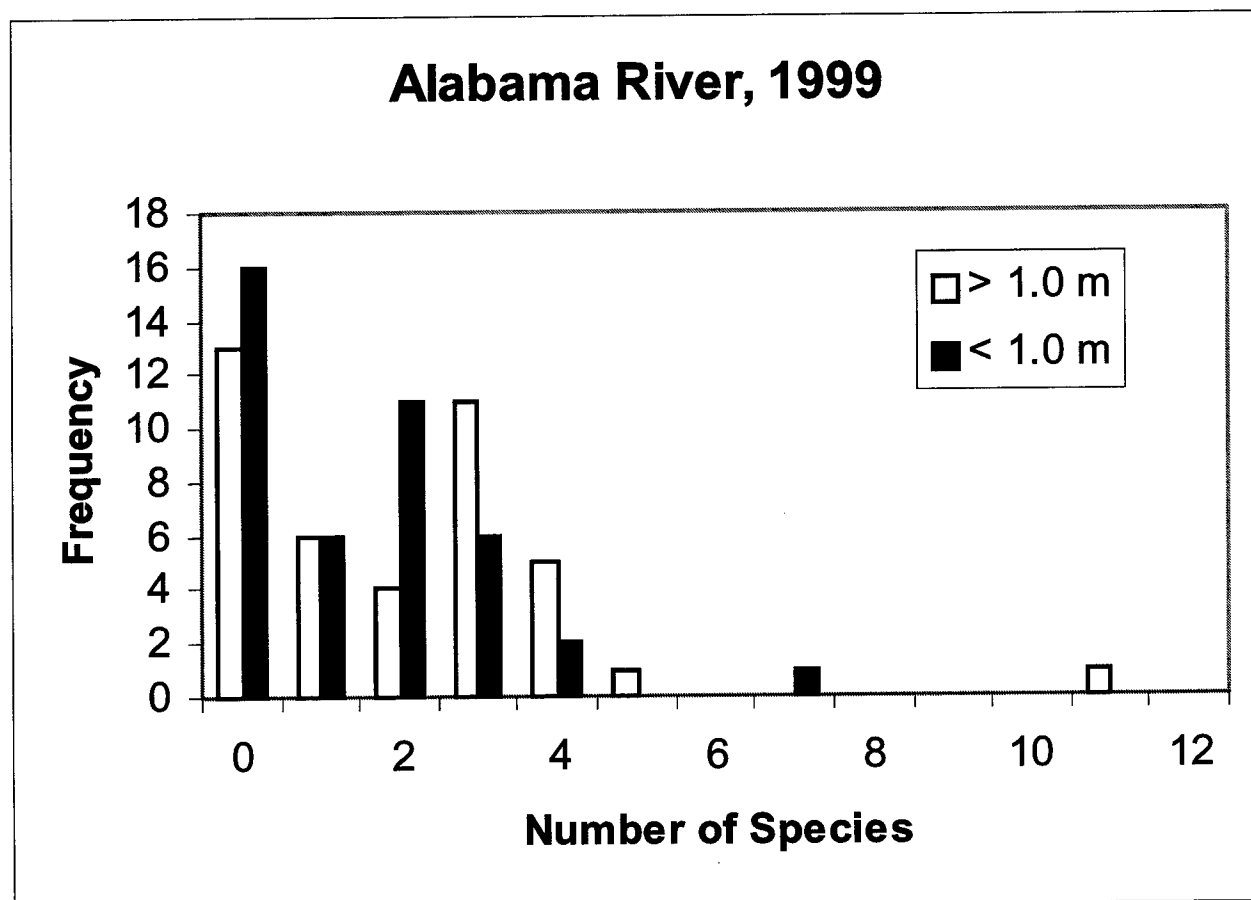


Figure 5. Frequency distribution of mussels species in shallow (<1.0 m) and deep water (>1.0 m), Alabama River, 1999

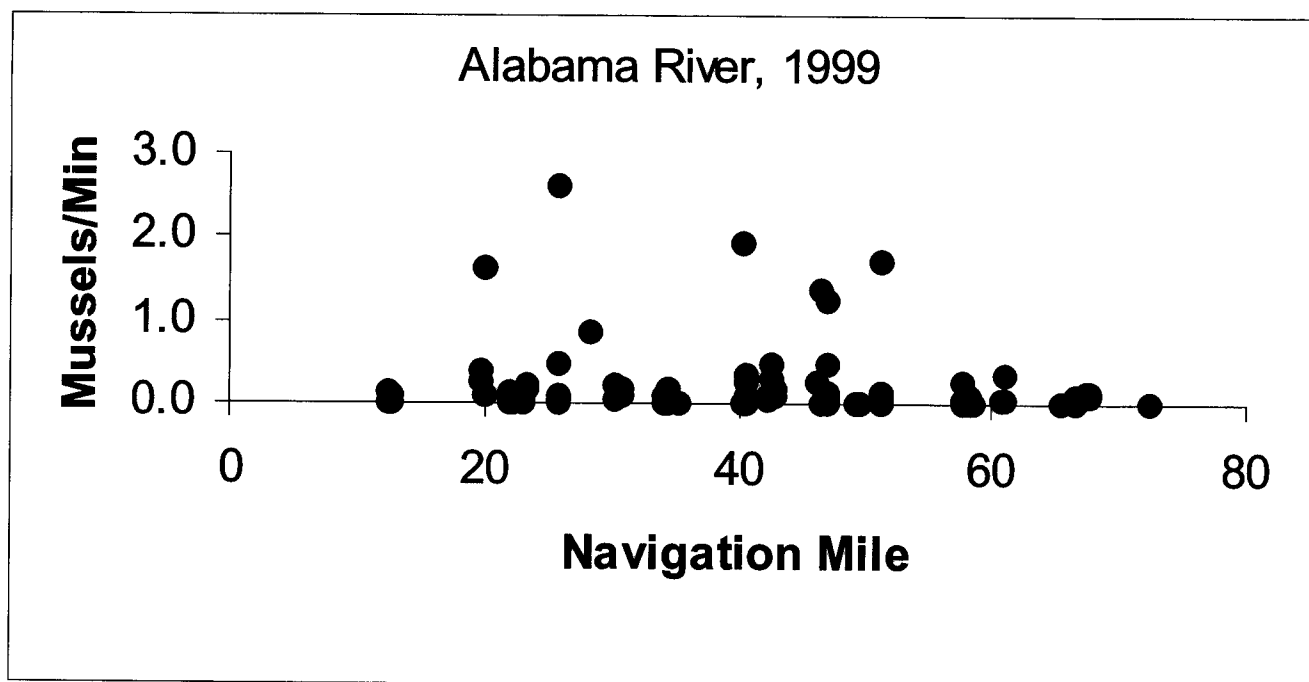


Figure 6. Mussel collecting rate versus navigation mile, Alabama River, 1999

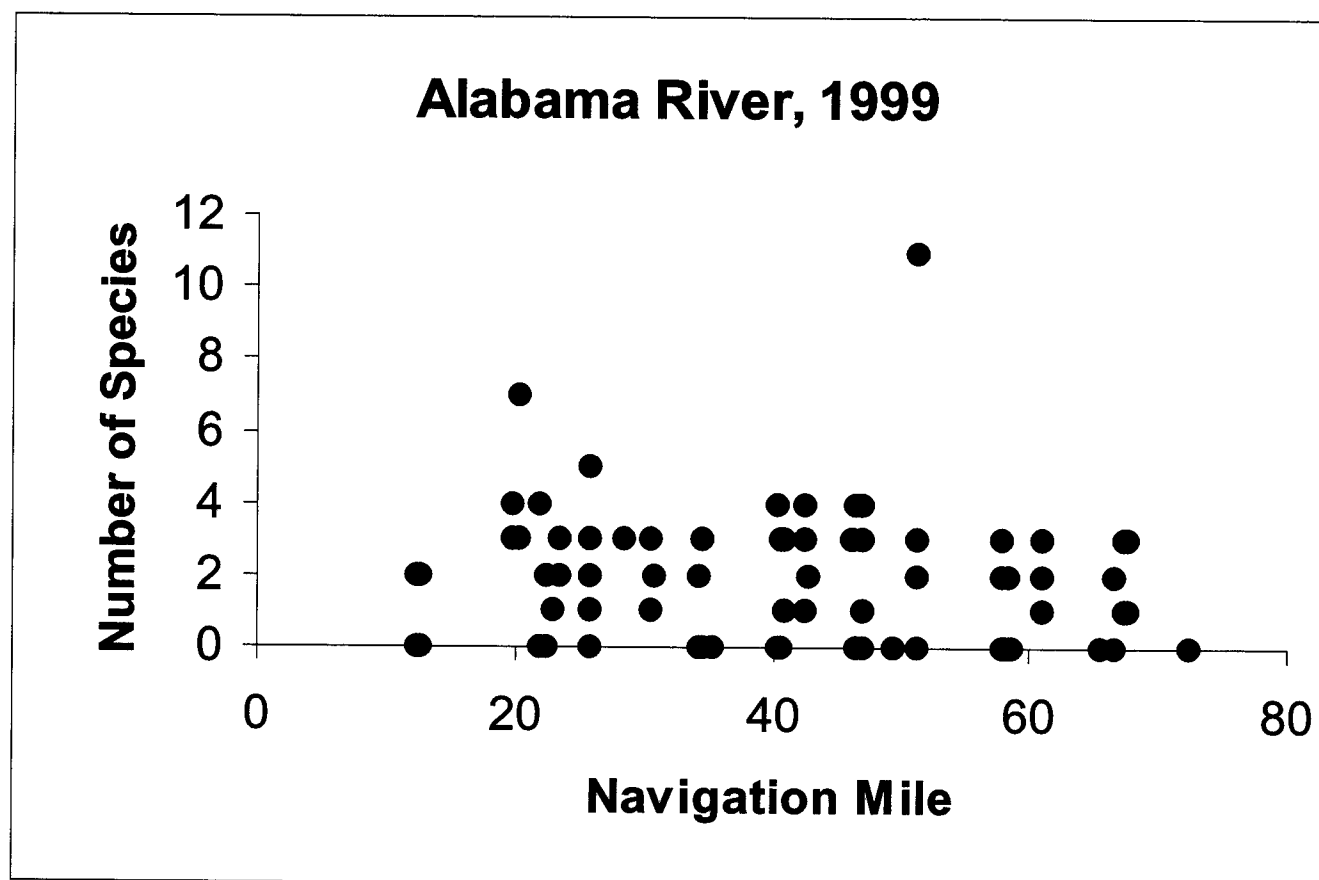


Figure 7. Number of species collected versus navigation mile, Alabama River, 1999

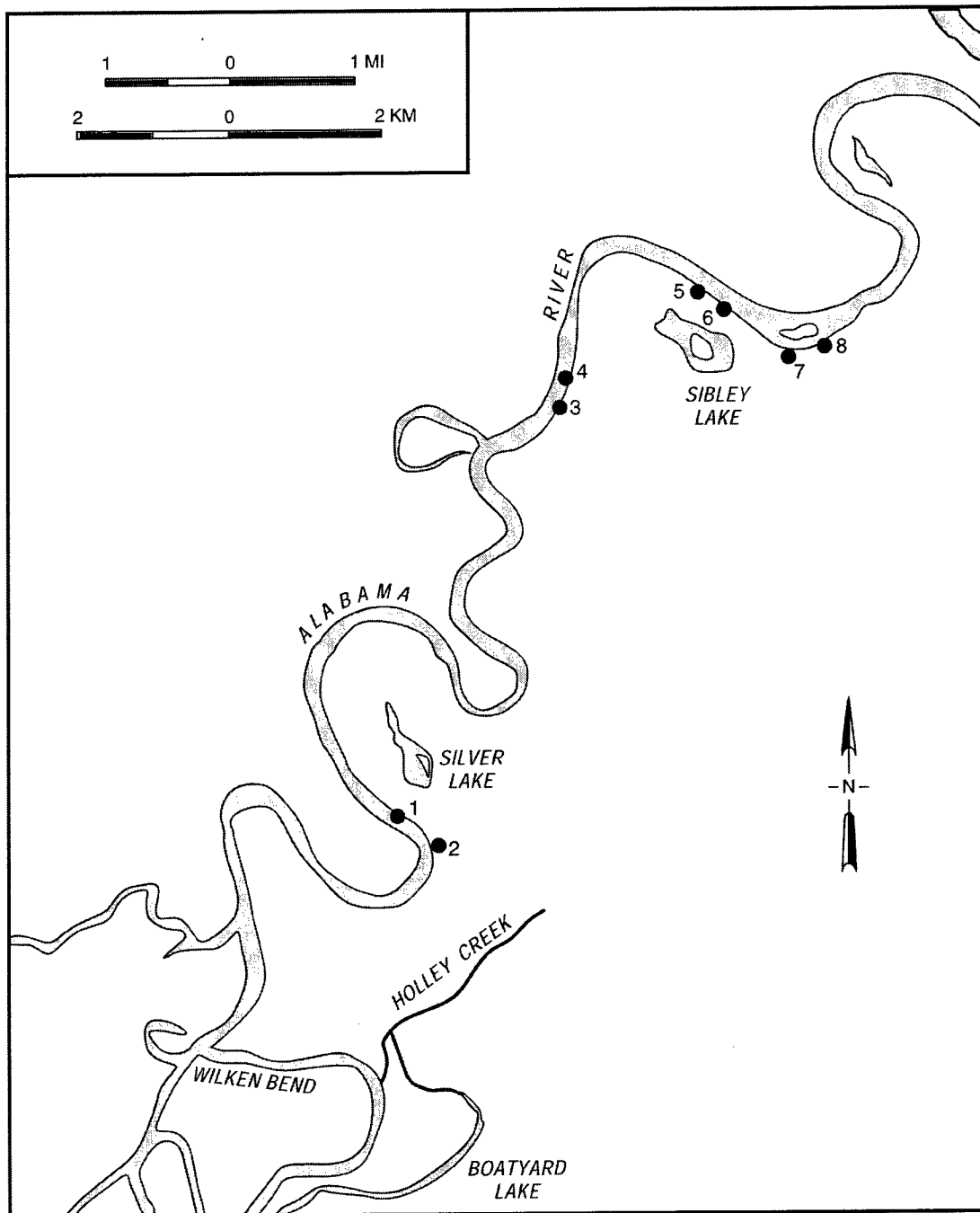


Figure 8. Collections at Wolf Gut (waypoints 1, 2), Aberdeen Wreck (waypoints 3, 4), Lower Earl's Bar (waypoints 5, 6), and Upper Earl's Bar (waypoints 7, 8), Alabama River, 1999

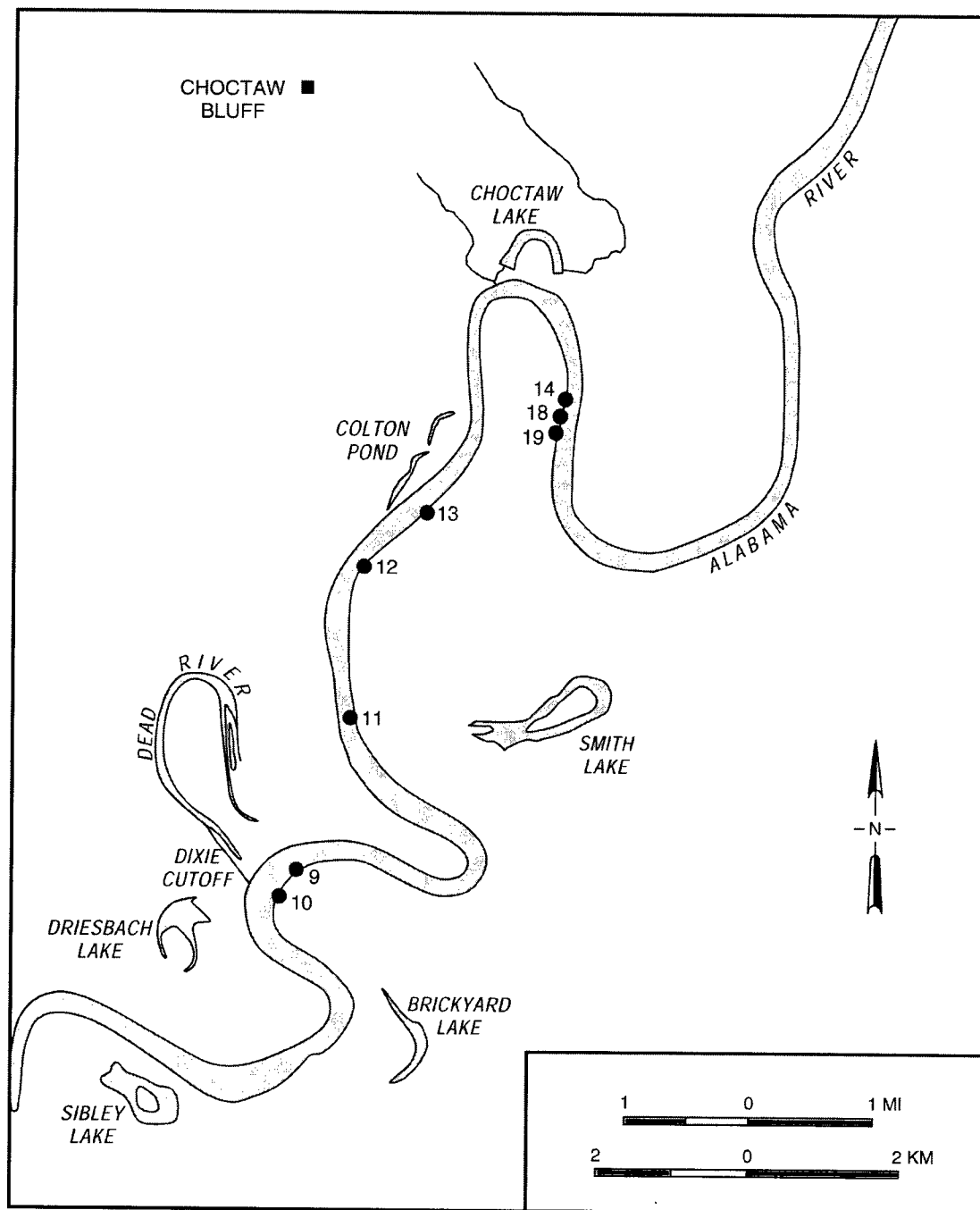


Figure 9. Collections at Dixie Cutoff (waypoints 9, 10), Lower Madison (waypoints 11-13), and Red Eagle Landing (waypoints 14, 18, 19), Alabama River, 1999

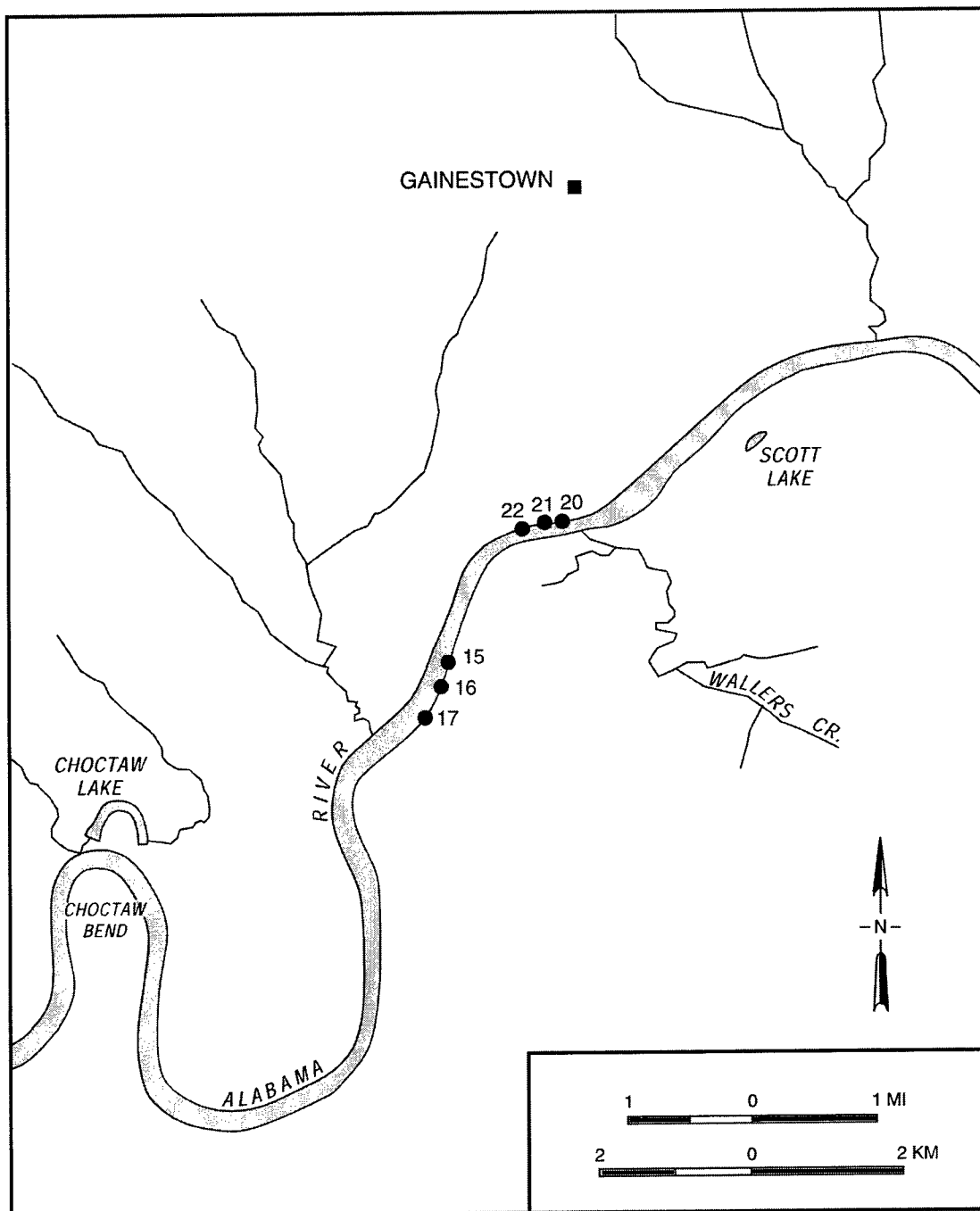


Figure 10. Collections at Carter's Bar (waypoints 15-17) and California Bar (waypoints 20-22), Alabama River, 1999

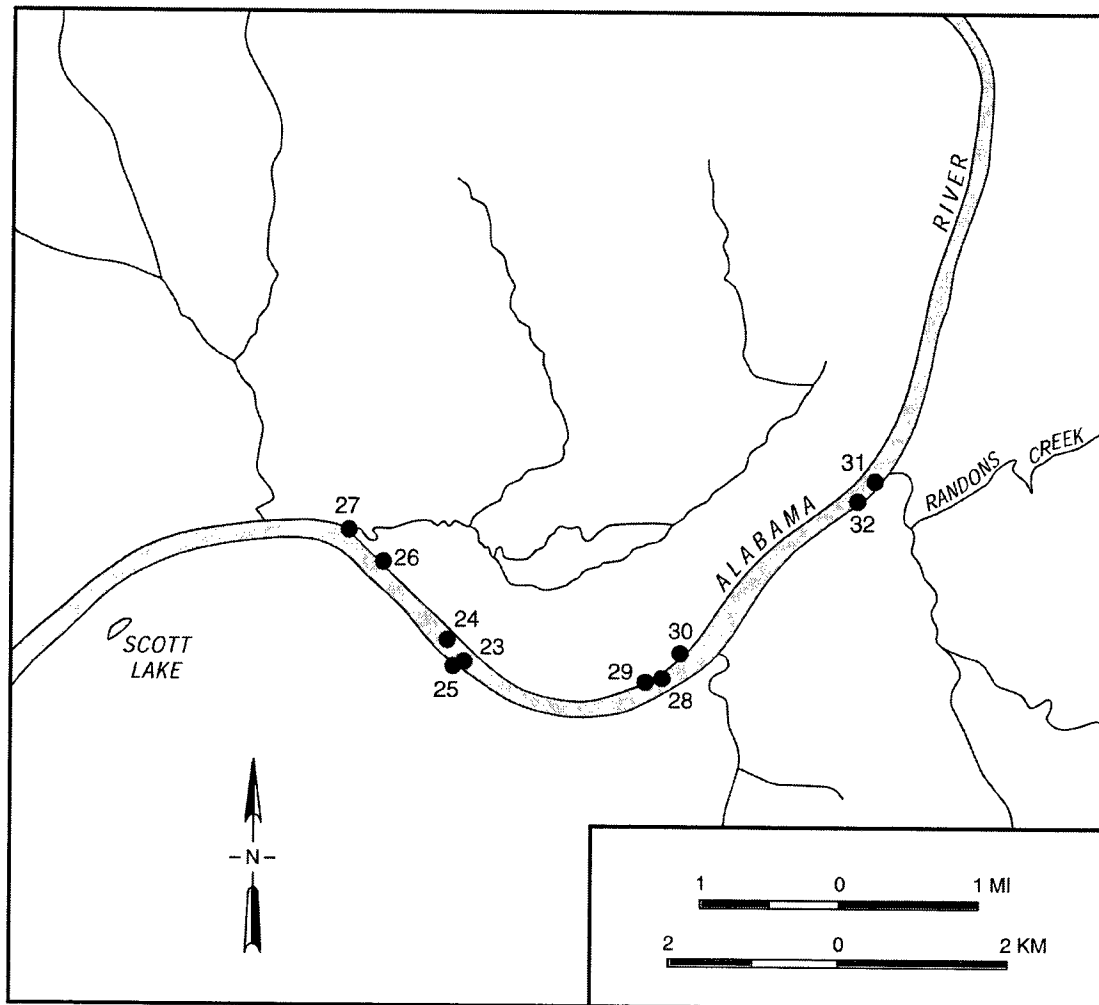


Figure 11. Collections at Shacklefield Dike Field (waypoints 23-27), Bailey Creek (28-30), Lovett's Creek (waypoints 31, 32), Alabama River, 1999

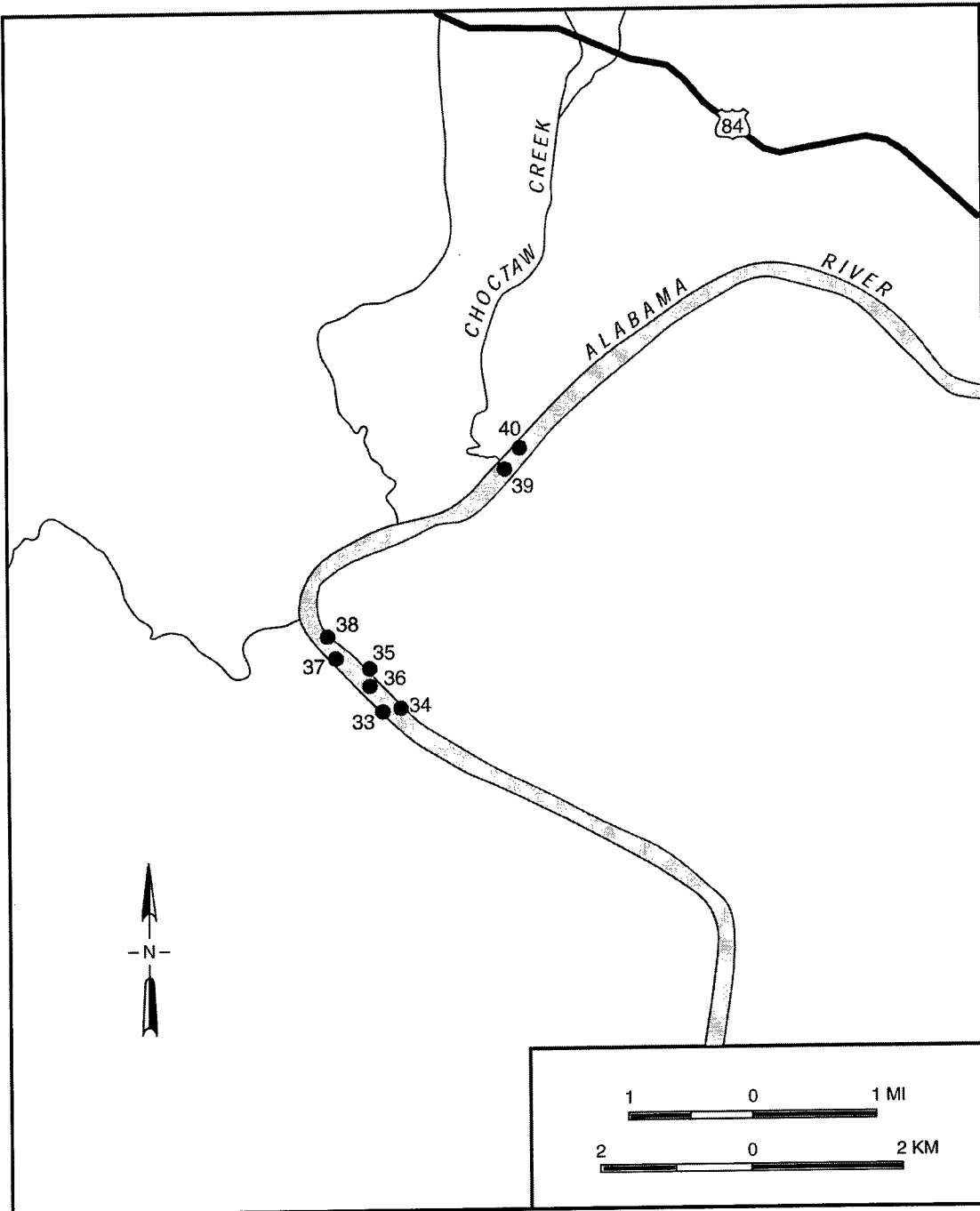


Figure 12. Collections at Mrs. Gray's Bar (waypoints 33-38) and Choctaw Creek (waypoints 39, 40), Alabama River, 1999

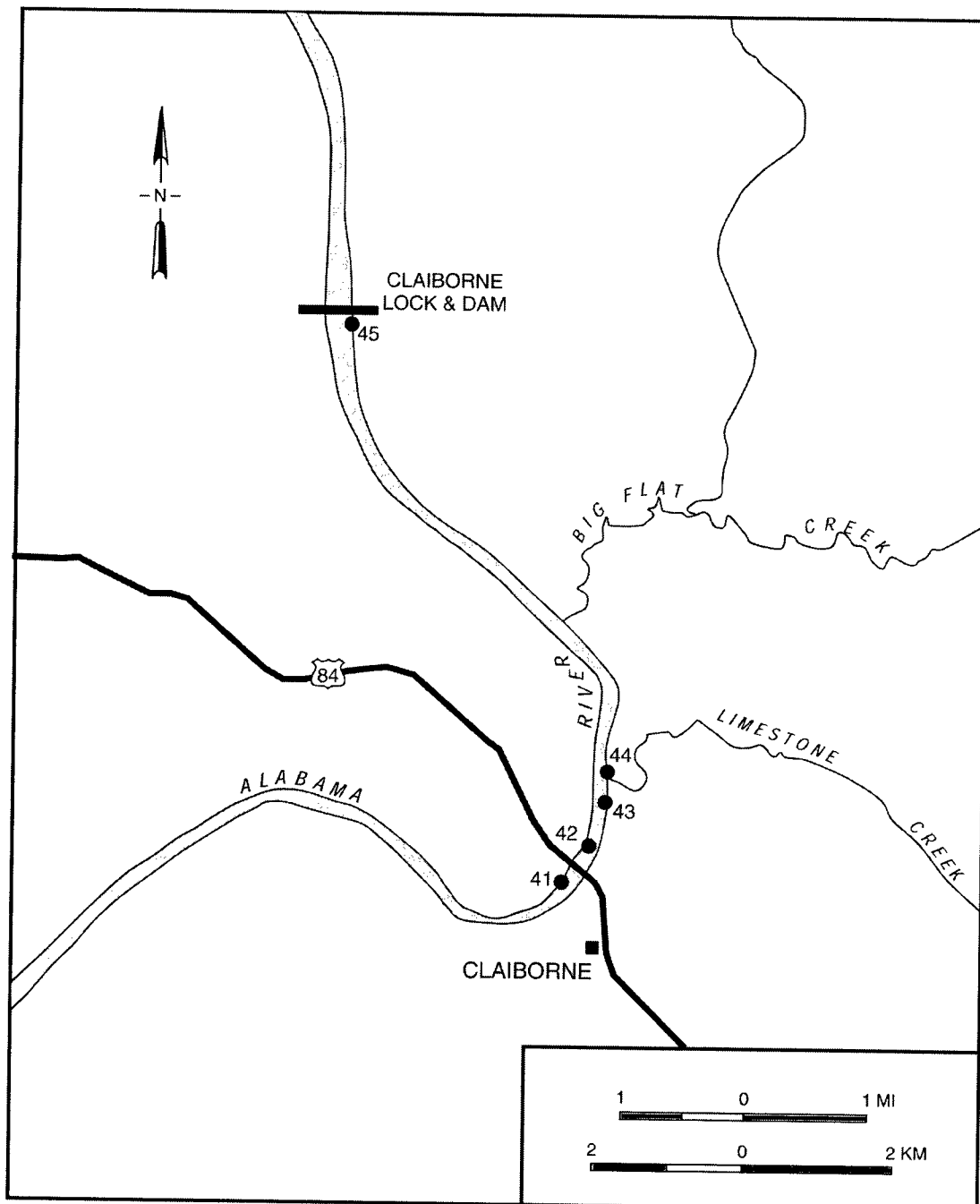


Figure 13. Collections at Claiborne Bridge (waypoints 41, 42), Limestone Creek (waypoints 43, 44), and next to the lock wall at Claiborne Lock and Dam (waypoint 45), Alabama River, 1999

REPORT DOCUMENTATION PAGE

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				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
				5d. PROJECT NUMBER	
6. AUTHOR(S) Andrew C. Miller				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
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13. SUPPLEMENTARY NOTES					
14. ABSTRACT In September 1999, 17 locations along the Alabama River between River Miles (RM) 12.5 and 72.4 were searched for freshwater mussels (Family: Unionidae) using divers and waders. Nearly 700 live mussels and 14 species were collected in addition to the nonindigenous Asian clam, <i>Corbicula fluminea</i> . The fauna was dominated by <i>Quadrula asperata</i> (Alabama orb) which composed 27.7 percent of the fauna. Four other species, <i>Obliquaria reflexa</i> (threehorn wartyback), <i>Fusconaia ebena</i> (ebonyshell), <i>Lampsilis teres</i> (yellow sandshell), and <i>Lampsilis ornata</i> (southern pocketbook), each composed 16.6 to 10.2 percent of the fauna. The total time spent collecting was 3,300 min, and collecting rates (where mussels were found) ranged from 0.02 to 0.69/min with an overall mean of 0.20 mussels/min. A single <i>Potamilus inflatus</i> (inflated heelspitter), listed as endangered, was collected in water approximately 2 m deep at RM 42.6, right descending bank. Aside from the single <i>P. inflatus</i> , no other unusual or uncommon mussels were found. All study sites had low-density mussel populations, usually with few species present.					
15. SUBJECT TERMS Alabama River, Dredging, Environmental impacts, Mussels, <i>Potamilus inflatus</i>					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 39	19a. NAME OF RESPONSIBLE PERSON
a. REPORT UNCLASSIFIED	b. ABSTRACT UNCLASSIFIED	c. THIS PAGE			19b. TELEPHONE NUMBER (include area code)